A.R.C.H.
CONSULTING GROUP, LLC

5607 Keystone Place North
Seattle, Washington 98103

(206) 301-8989 – office

(www.archconsultants.com

December 10, 2012

Bill Haugen
City of Lynnwood Parks, Recreation & Cultural Arts
18900 44th Avenue West
Lynnwood, Washington 98046-5008

2012 CHLORINE & CHLORAMINE TESTING - LYNNWOOD RECREATION CENTER
18900 44th Avenue West, Lynnwood, Washington

Dear Mr. Haugen,

On November 3 – 4, 2012, A.R.C.H. Consulting Group, LLC performed chlorine & chloramine (nitrogen trichloride) adjacent to the pool in the North Natatorium (AKA Rec or Family Pool), and indoor air quality testing (IAQ) in the North and South Natatoriums.

PURPOSE: The following objectives were completed.

1. Employees' personal exposures to chlorine and chloramine were measured throughout an entire work shift on November 3, 2012.

2. The chlorine and chloramine air concentrations were measured in the North Natatorium (family pool) from 1 to 8:45 pm in three hour segments.

3. Fifteen minute chlorine air samples were collected in the North & South Natatoriums.

4. The "comfort indicators" (carbon dioxide [CO_2], temperature & percent relative humidity) and carbon monoxide (CO) were constantly measured in the North & South Natatorium from approximately 9:30 am on November 3, 2012 to 3 pm on November 4, 2012.

5. The water chemistry data (collected by Rec Center staff) was correlated with the air sample results (collected by A.R.C.H. Consulting).

APPENDICES:

Appendix 1: Chlorine & Chloramine (Nitrogen Trichloride) Laboratory Results
Appendix 2: North Pool (Family Pool) Indoor Air Quality Results
Appendix 3: South Pool (Lap Pool) Indoor Air Quality Results
Appendix 4: Water Chemistry Data
Appendix 5: 2011 Test Results

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SAMPLING METHODS:

Chlorine & Chloramine Area Air Samples: Three sets of three hour area air samples were collected on November 3, 2012. Chlorine was collected using silver membrane closed face air sampling filters at a flow rate of 1.0 liter of air per minute (lpm); chloramine was collected using treated quartz and 2 micron PTFE filters at a flow rate of 1.0 lpm. Air samples were collected adjacent to the center of the bleachers where the observers usually sit. This is the same location where the samples were collected in the 2011 testing. Samples were collected approximately 5 feet off the floor. All air samples were analyzed by Galson Laboratories in East Syracuse, NY.

Chlorine Grab Samples: Fifteen minute air samples were collected at various times throughout the day to measure the chlorine Ceiling Limit. The Draeger CMS Chip Measurement System, an electronic colorimetric grab sampling system, was used to collect the air samples. Error for the measurements was plus or minus 35%.

Personal Exposure Samples: Two employees each wore a sampling pump for 8-hours on November 3, 2012 while they performed their normal duties in both the North & South Natatorium. Kari Sjolin wore a sampling pump to measure her chloramine exposure. Ms. Sjolin wore the pump from 12:50 pm to 8:57 pm. Stephen Norman wore a sampling pump to measure his chlorine exposure. Mr. Norman wore the pump from 12:54 pm to 8:50 pm.

Indoor Air Quality Testing: Indoor Air Quality sampling was performed using TSI Indoor Air Quality Meters. In the North Pool a TSI Model 7565 meter was used; in the South Pool a TSI Model 8554 meter was used. Both probes were calibrated according to Manufacturer's recommendations.

OCCUPATIONAL EXPOSURE LIMITS:

1. In the State of Washington there are two separate Permissible Exposure Limits (PELs) for workers' exposure to chlorine vapors:

    a. The 8-hour Time-Weighted Average (TWA) Limit that states, during the workday the average exposure to workers must be less than 0.5 ppm (parts of chlorine per million parts of air) during an 8-hour work shift, and

    b. The Ceiling Limit that states workers cannot be exposed to more than 1.0 ppm chlorine at any time during the work day.

2. There is no PEL for chloramines.

FINDINGS:

Chlorine & Chloramine in the North (Family) Pool:

1. **Personal (Employee) Exposures:** The measured workers' exposures were as follows:
   a. Chlorine = 0.068 ppm as an 8-hour time-weighted average exposure.
   b. Chloramine = 0.15 ppm as an 8-hour time-weighted average exposure.

2. **Area Air Samples Family Pool:** The 8-hour time-weighted average air concentration for chlorine & chloramine in the vicinity of the bleachers in the North Family Pool (see Photo 1) on Saturday November 3, 2012 from approximately 1 pm to 8:45 pm was as follows:
   a. Chlorine = 0.16 ppm as an 8-hour average air concentration.
   b. Chloramine = 0.28 ppm as an 8-hour average air concentration.

3. **Ceiling Level:** The 15-minute Chlorine Ceiling Limit air samples are summarized in Table 1 below. No Ceiling Limit samples were collected in 2011.

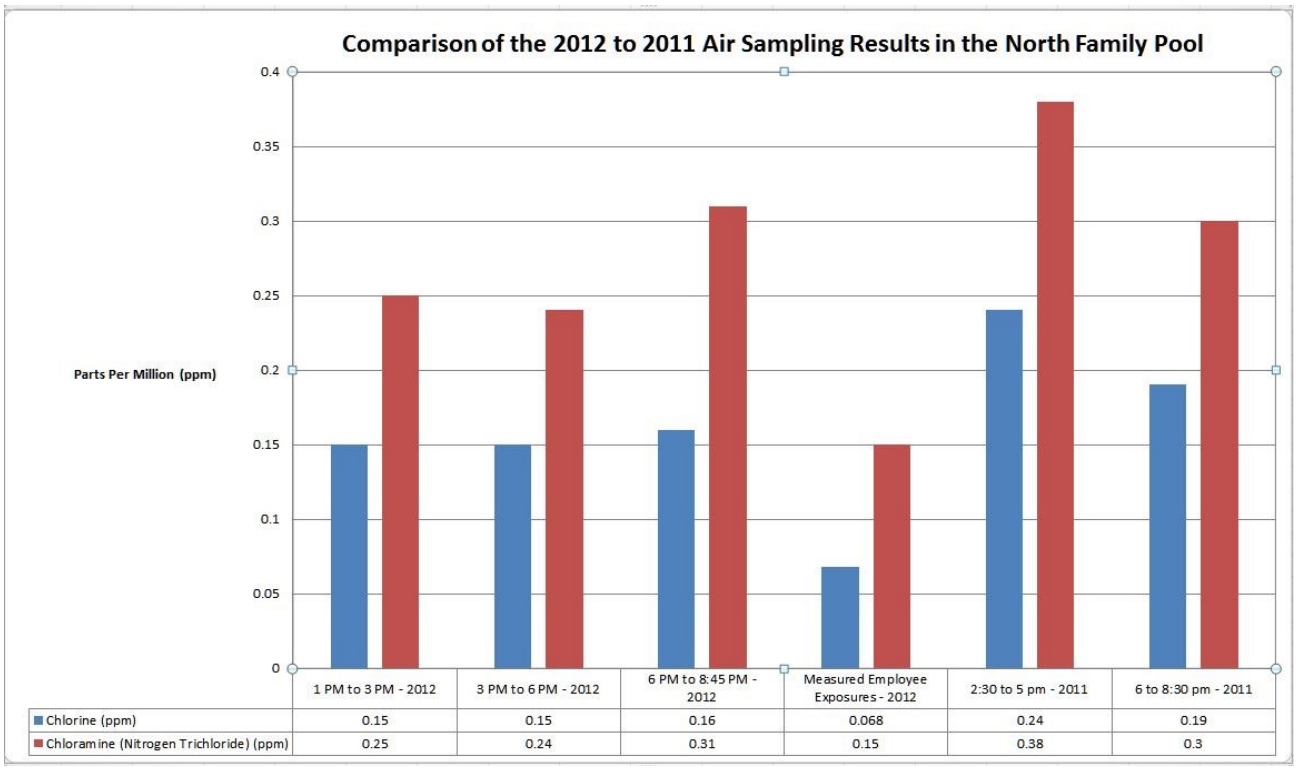
Table 1: Chlorine 15-Minute Air Sample Results

Time Sample was Collected	Sample Location	Results in ppm (Ceiling Exposures)
2:45 to 3:00 pm on 11/3/12	Family Pool	0.27 ppm +/- 0.09 ppm
5:30 to 5:45 pm "	Family Pool	0.44 ppm +/- 0.15 ppm
6:00 to 6:15 pm "	Family Pool	0.50 ppm +/- 0.17 ppm
8:30 to 8:45 pm "	Family Pool	0.73 ppm +/- 0.25 ppm
3:00 to 3:15 pm on 11/4/12	Family Pool	0.24 ppm +/- 0.08 ppm
5:45 to 6:00 pm on 11/3/12	Lap Pool	<0.20 ppm
8:30 to 8:45 pm "	Lap Pool	<0.20 ppm

<0.2 ppm indicates no chlorine was detected

FINDINGS (continued):

4. Comparison between August 2011 and November 2012 air sampling for chlorine and chloramine.



	1 PM to 3 PM - 2012	3 PM to 6 PM - 2012	6 PM to 8:45 PM - 2012	Measured Employee Exposures - 2012	2:30 to 5 pm - 2011	6 to 8:30 pm - 2011
Chlorine (ppm)	0.15	0.15	0.16	0.068	0.24	0.19
Chloramine (Nitrogen Trichloride) (ppm)	0.25	0.24	0.31	0.15	0.38	0.3

- Average air concentration in 2012: Chlorine = 0.16 ppm
  Chloramine = 0.28 ppm

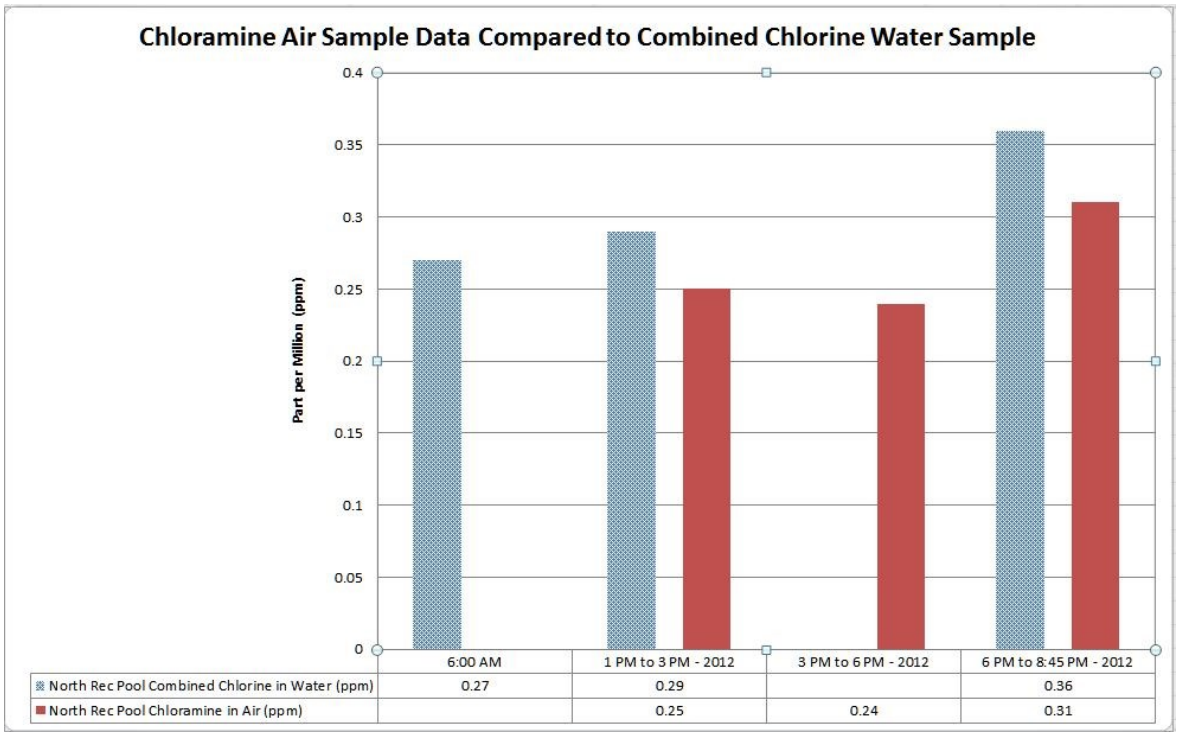
- Average air concentration in 2011: Chlorine = 0.21 ppm
  Chloramine = 0.34 ppm

The North Family Pool was full during all of the open swim times. There were approximately 300 people in the North Family Pool natatorium during the three open swims (Photo 1).

FINDINGS (continued):

Correlating Water Data to Air Sampling Data

5. The chloramine air sample data correlated the best with the combined chlorine water sample.



- The ratio between Chloramines in air versus Combined Chlorine in Water is approximately 0.86. Multiply the Combined Chlorine water sample by 0.86 to obtain the approximately airborne chloramine level.

0.36 ppm Combined Chorine X 0.86 = 0.31 ppm Chloramine in air

The 0.86 ration between air samples to water samples is only valid under the current ventilation conditions. If additional ventilation is added (more outside air) or if fans are installed to ventilate certain areas this ratio would no longer be valid.

FINDINGS (continued):

Using the Combined Chlorine to Chloramine Ratio

6. Using the ratio of the Chloramine in air to the Combined Chlorine in water of 0.86 (from the page above), the estimated chloramine air concentration in the other areas of the Rec Center is shown below.

		Measured Combined Chlorine (CL2) level in Pool Water (ppm)	Ratio 0.8	**Estimated Chloramine level in air (ppm)**
Lap Pool	6:15 AM	0.08	0.86	**0.07**
	1:25 PM	0.08	0.86	**0.07**
	9:00 PM	0.13	0.86	**0.11**
Wellness Pool	6:15 AM	0.08	0.86	**0.07**
	1:25 PM	0.16	0.86	**0.14**
	9:00 PM	0.27	0.86	**0.23**
Adult Hot Tub	6:15 AM	0.20	0.86	**0.17**
	1:25 PM	0.37	0.86	**0.32**
	9:00 PM	0.38	0.86	**0.33**
Rec Pool	6:15 AM	0.27	0.86	**0.23**
	1:25 PM	0.29	0.86	**0.25**
	9:00 PM	0.36	0.86	**0.31**
Family Hot Tub	6:15 AM	0.43	0.86	**0.37**
	1:25 PM	0.65	0.86	**0.56**
	9:00 PM	0.74	0.86	**0.64**

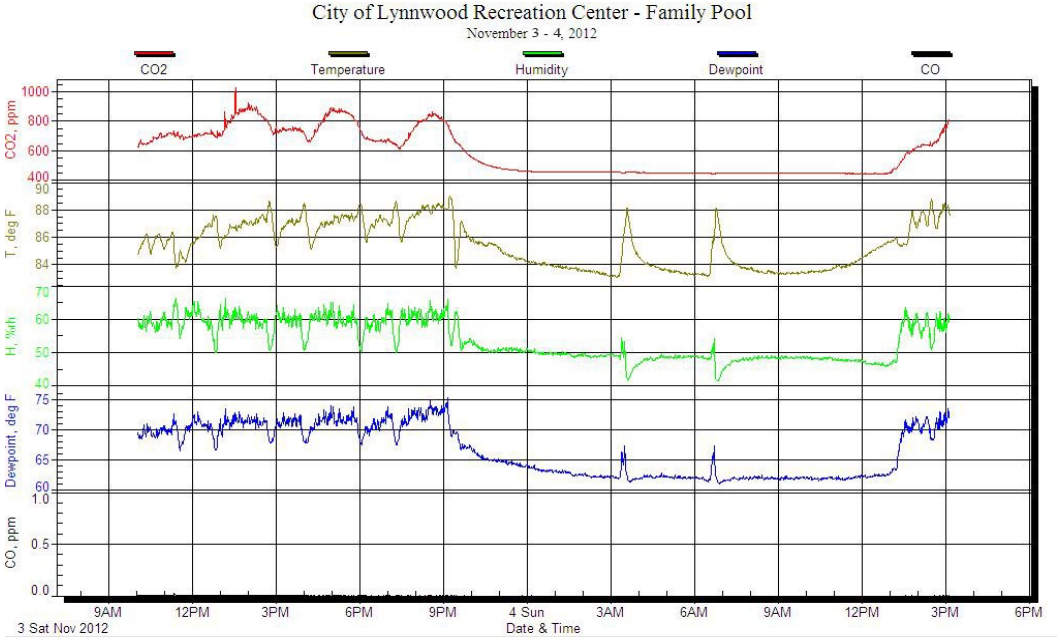
Chloramines are the main cause of skin, eye & respiratory irritation of people using pools. Airborne concentrations of chloramine begin to cause irritation of the skin, eyes, and respiratory system at concentrations of 0.3 to 0.5 ppm.

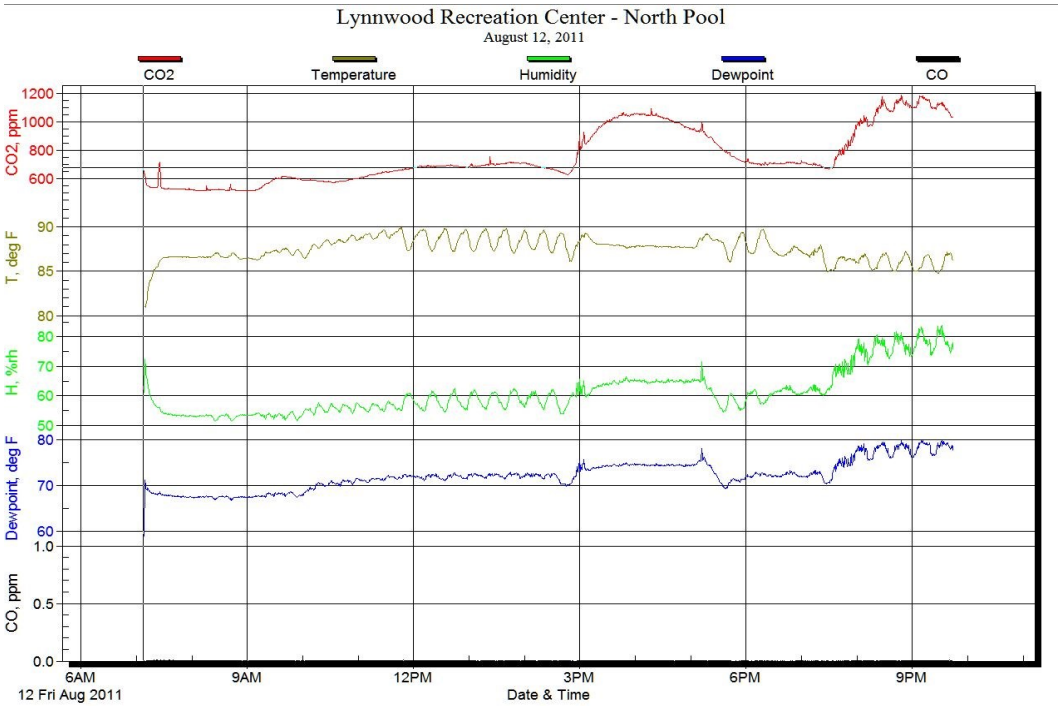
Chlorine can be smelled at 0.2 ppm but chlorine only causes slight irritation at 3 to 5 ppm.

FINDINGS (continued):

Indoor Air Quality Test Results – North Family Pool

7. Comparison between 2012 (top chart) and 2011 in the North Family Pool

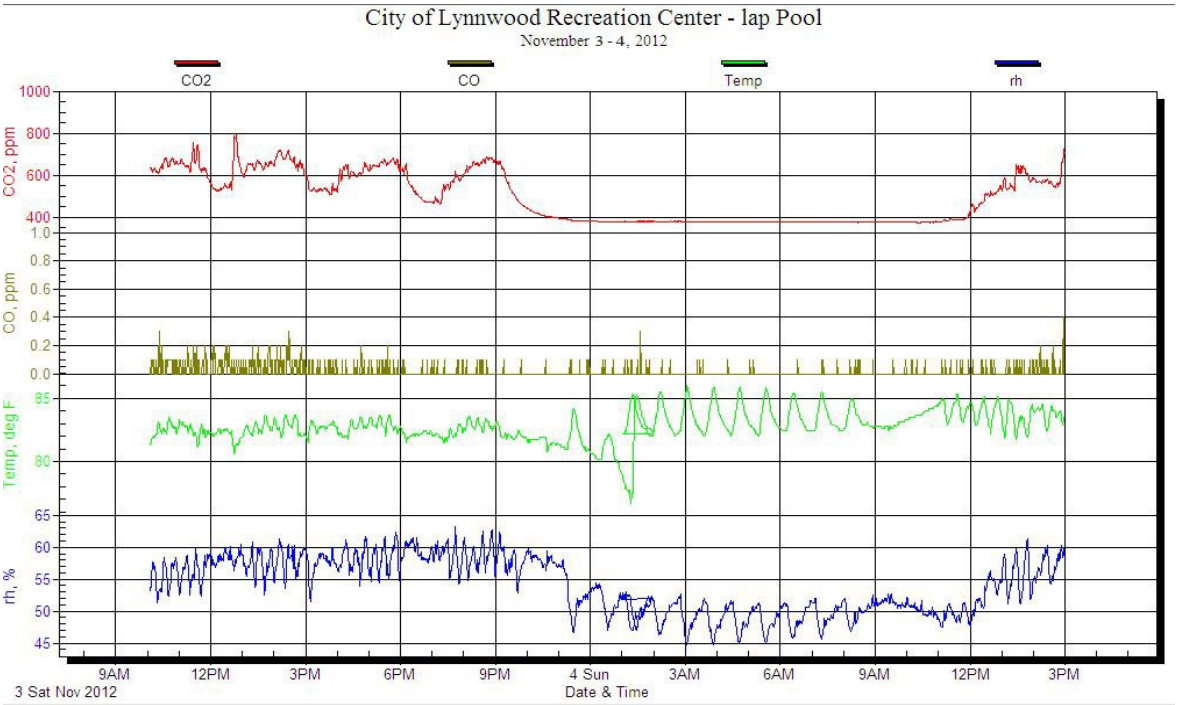


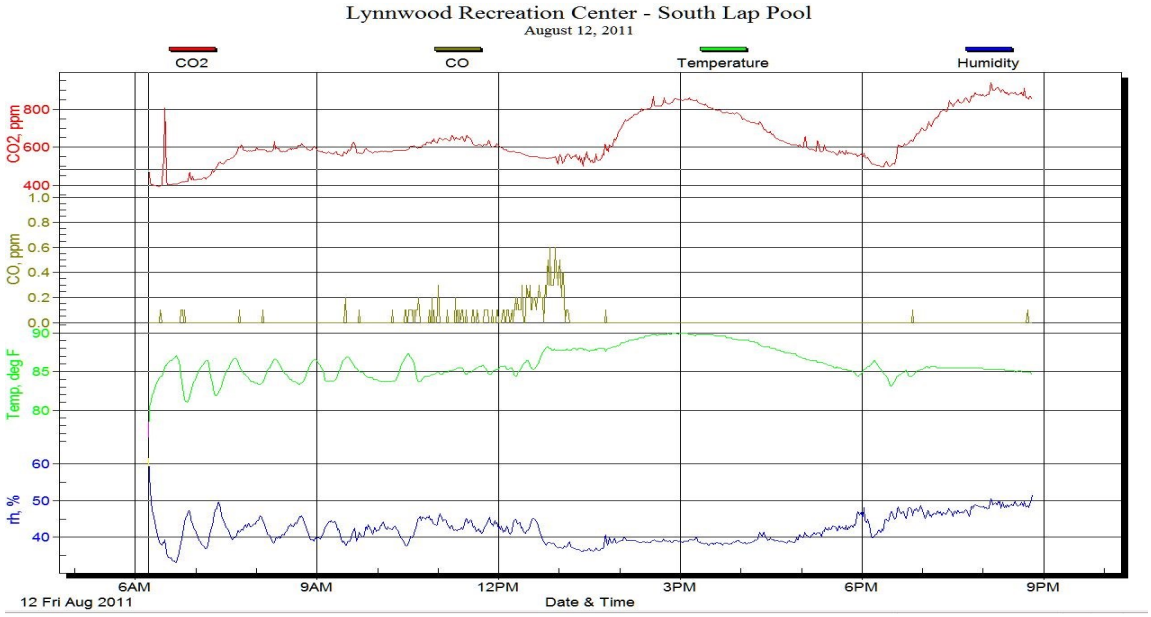


FINDINGS (continued):

Indoor Air Quality Test Results – South La Pool

8. Comparison between 2012 (top chart) and 2011 in the South Lap Pool





CONCLUSIONS:

Personal (Employee) Exposures: (Page 3 & Appendix 1)

1. *Chlorine* – The 8-hour time-weighted average personal exposure for chlorine was well below the Permissible Exposure Limit (PEL). The measured exposure was 0.068 ppm chlorine; the PEL is 0.5 ppm.

2. *Chloramine* – There is no PEL for chloramine, but the 8-hour time-weighted average personal exposure for chloramine was 0.15 ppm. This level is below the level that causes irritation in some people.

Chlorine & Chloramine Air Concentrations in Family Pool: (Page 4 & Appendix 1).

3. *Chlorine:* The average air concentration in the Family Pool ranged from 0.15 ppm to 0.16 ppm. The white arrow in the photo to the right shows the location of all the area air sampling.

4. *Chloramine:* The average air concentration of chloramine in the Family Pool ranged from 0.24 to 0.31 ppm. After 6 pm the level rose above 0.3 ppm, the level that may cause irritation in some people.

Photo 1: North Family Pool
White Arrow Indicates Air Sampling Location

Ceiling Limits – Chlorine: (Page 3)

5. The 15-minute air concentration of chlorine in the Family Pool rose above 0.7 ppm after 8:30 pm. The Ceiling Limit for chlorine is 1.0 ppm, that is, chlorine levels cannot rise above 1 ppm at any time. The collection method has an error of plus or minus 35%. All Ceiling Limit measurements were below the Ceiling Limit of 1.0 ppm.

Comparison of Chlorine & Chloramine Levels between 2011 & 2012 Surveys: (Page 4)

6. *Chlorine*: The airborne chlorine level in the Family Pool decreased approximately 30% from the 2011 measurements.

7. *Chloramine*: The airborne chloramine levels in the Family Pool decreased approximately 42% from the 2011 measurements, although in 2012 after 6 pm the chloramine level rose above 0.3 ppm.

CONCLUSIONS (continued):

Ration of Combined Chlorine water samples to the Chloramine Air Samples: (Pages 5 & 6)

8. The ratio of the chloramine air sample results to the combined chlorine water sample results was constant at 0.86, although only two samples were used. Using this ratio the chloramine air concentration at other areas in the natatoriums could be estimated. (*Please note if the ventilation is changed in any way, such as adding more outside air or installing fans, this ratio would not be valid*).

9. The table on page 6 shows the Lap Pool and Wellness Pools remain below 0.3 ppm chloramine throughout the day.

10. The Adult and Family Hot Tubs exceed 0.3 ppm during most of the day. Chloramines above 0.3 ppm can cause some people irritation.

11. The Family Pool did not exceed 0.3 ppm chloramines until the final open swim between 6 and 9 pm.

Indoor Air Quality Conclusions: (Pages 7 & 8)

12. The carbon dioxide (CO_2) level, which is an indirect indicator of the amount of outside air brought into the building, was significantly lower in 2012 compared to 2011. The CO_2 levels in 2012 did not exceed 900 ppm; in 2011 the CO_2 levels reached 1200 ppm.

    CO_2 levels above 1000 ppm make the area uncomfortably "stuffy".

13. The Lap Pool's CO_2 concentration remained below 700 ppm, even lower than in 2011

14. The only anomaly seen regarding the temperature and humidity was after 8 pm in the Family Pool. After 8 pm the temperature rose slightly as did the chloramine and chlorine levels. This may be an indication that after 8 pm the amount of outside air was reduce.

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RECOMMENDATIONS

The only recommendation is to attempt to control the chloramine levels to remain below 0.3 ppm. This will decrease the amount of irritation experience by some people.

Additional ventilation or fans should be positioned near the hot tubs, especially the Family Hot Tub, to dilute the chloramine vapors below 0.3 ppm.

Thank you very much for allowing A.R.C.H. Consulting Group the opportunity to perform this work. Please call if you need clarification or more details.

A.R.C.H. Consulting Group is owned and operated by Certified Industrial Hygienists who can assist in any health and safety concern you have. We specialize in evaluating your workers exposures to air contaminants, measuring personal noise exposures and performing sound level surveys, indoor air quality assessments and investigations, mold assessments and mold abatement protocols, radiation surveys, and safety & hazard evaluations.

Please call me in the office at (206) 301-8989, on my cell phone at (206) 618-3088, or email at frank@archconsultants.com if you have any questions or concerns.

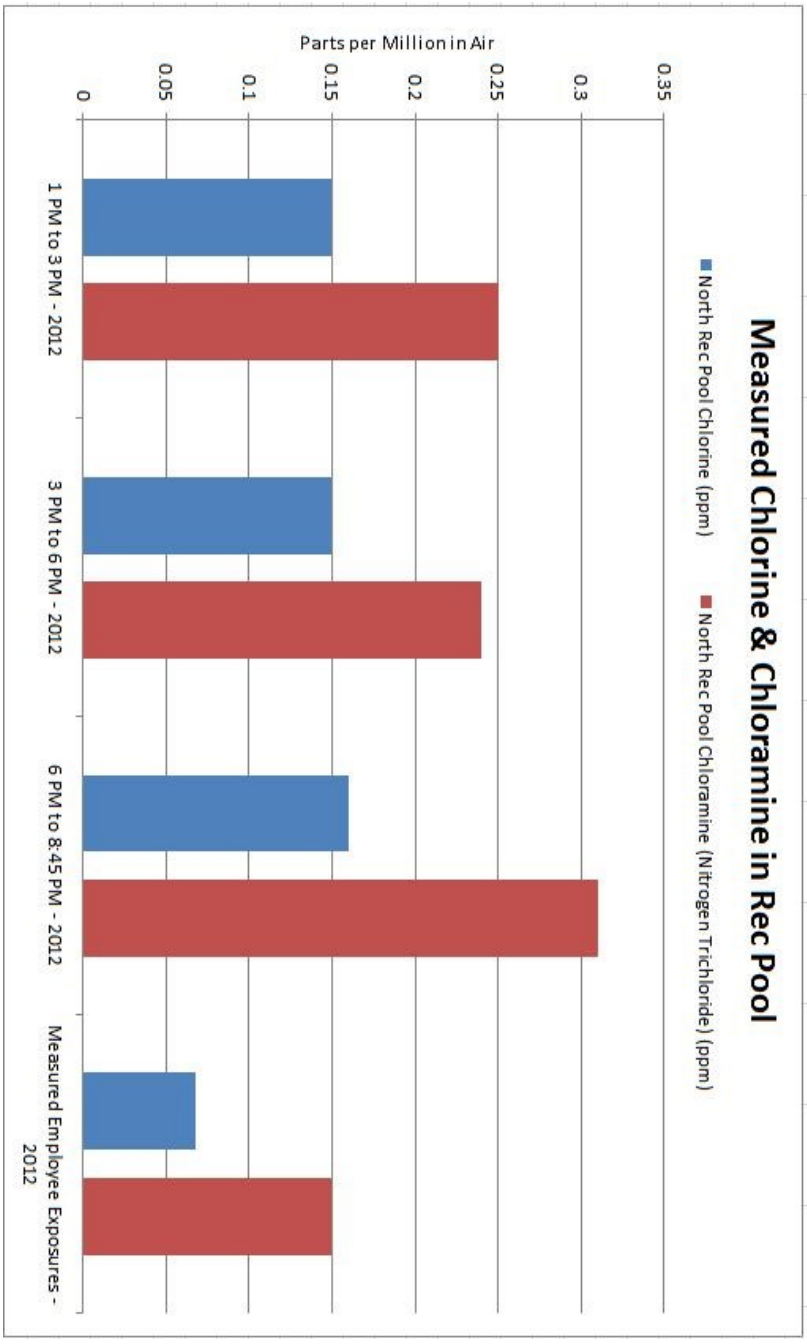
Sincerely,

Frank Riordan
Certified Industrial Hygienist

APPENDIX 1

2012 RESULTS

CHLORINE & CHLORAMINE (NITROGREN TRICHLORIDE) AIR SAMPLE RESULTS


Measured Chlorine & Chloramine in Rec Pool
North Rec Pool Chlorine (ppm)
North Rec Pool Chloramine (Nitrogen Trichloride) (ppm)
Parts per Million in Air
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 PM to 3 PM - 2012
3 PM to 6 PM - 2012
6 PM to 8:45 PM - 2012
Measured Employee Exposures - 2012

A.R.C.H.
CONSULTING GROUP, LLC

GALSON
LABORATORIES

Mr. Frank Riordan
A.R.C.H. Consulting Group
5607 Keystone Place North
Suite B
Seattle, WA 98103

November 12, 2012

DOH ELAP# 11626 Account# 14670 Login# L277617
AIHA # 100324

Dear Mr. Riordan:

Enclosed are the analytical results for the samples received by our laboratory on November 06, 2012. All test results meet the quality control requirements of AIHA and NELAC unless otherwise stated in this report. All samples on the chain of custody were received in good condition unless otherwise noted.

Results in this report are based on the sampling data provided by the client and refer only to the samples as they were received at the laboratory. Unless otherwise requested, all samples will be discarded 14 days from the date of this report.

Current Scopes of Accreditation can be viewed at www.galsonlabs.com in the accreditations section under the "about Galson" tab.

Please contact Heidi Fruhlinger at (888) 432-5227, if you would like any additional information regarding this report.

Thank you for using Galson Laboratories.

Sincerely,

Galson Laboratories

Mary G Unangst

Mary G. Unangst
Laboratory Director

Enclosure(s)

A.R.C.H.
CONSULTING GROUP, LLC

GALSON LABORATORIES

LABORATORY ANALYSIS REPORT

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Client : A.R.C.H. Consulting Group
Site : Lynnwood Rec Center
Project No. : 2012-1525

Date Sampled : 03-NOV-12 Account No.: 14670
Date Received : 06-NOV-12 Login No. : L277617
Date Analyzed : 08-NOV-12
Report ID : 759365

Chlorine

Sample ID	Lab ID	Air Vol liter	Total ug	Conc mg/m3	ppm
#2-CI-1-3	L277617-5	134.2	57	0.43	0.15
#4-CI-3-6	L277617-6	181.5	77	0.43	0.15
#6-CI-6-8:45	L277617-7	185.9	88	0.47	0.16
#8-STEPHEN-CI	L277617-8	528	100	0.20	0.068

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 5 ug
Analytical Method : mod. NIOSH 6011; IC
OSHA PEL (TWA) : 1 ppm Ceiling
Collection Media : 225-9006

Submitted by: tmk
Approved by : dnf
Date : 12-NOV-12 NYS DOH # : 11626
QC by: Tony D'Amico

< -Less Than mg -Milligrams m3 -Cubic Meters kg -Kilograms
> -Greater Than ug -Micrograms l -Liters NS -Not Specified
NA -Not Applicable ND -Not Detected ppm -Parts per Million

A.R.C.H.
CONSULTING GROUP, LLC

GALSON LABORATORIES

LABORATORY ANALYSIS REPORT

6601 Kirkville Road
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www.galsonlabs.com

Client : A.R.C.H. Consulting Group
Site : Lynnwood Rec Center
Project No. : 2012-1525

Date Sampled : 03-NOV-12 Account No.: 14670
Date Received : 06-NOV-12 Login No. : L277617
Date Analyzed : 06-NOV-12 - 07-NOV-12
Report ID : 759144

Nitrogen Trichloride

Sample ID	Lab ID	Air Vol liter	Front ug	Back ug	Total ug	Conc mg/m3	ppm
#1-NCI3-1-3	L277617-1	134.2	160	6.0	160	1.2	0.25
#3-NCI3-3-6	L277617-2	181.5	210	6.8	210	1.2	0.24
#5-NCI3-6-8:45	L277617-3	185.9	270	11	280	1.5	0.31
#7-KARI-NCI3	L277617-4	535.7	390	18	410	0.76	0.15

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 6 ug Submitted by: KLS/TMK
Analytical Method : In-house: II-NCL3; IC Approved by : dnf
OSHA PEL (TWA) : N/A Date : 09-NOV-12 NYS DOH # : 11626
Collection Media : MNCL3 QC by: Tony D'Amico

< -Less Than mg -Milligrams m3 -Cubic Meters kg -Kilograms
> -Greater Than ug -Micrograms l -Liters NS -Not Specified
NA -Not Applicable ND -Not Detected ppm -Parts per Million

A.R.C.H.
CONSULTING GROUP, LLC

GALSON LABORATORIES

LABORATORY FOOTNOTE REPORT

Client Name : A.R.C.H. Consulting Group
Site : Lynnwood Rec Center
Project No. : 2012-1525

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Date Sampled : 03-NOV-12
Date Received: 06-NOV-12
Date Analyzed: 07-NOV-12 - 08-NOV-12

Account No.: 14670
Login No. : L277617

Unless otherwise noted below, all quality control results associated with the samples were within established control limits.

Unrounded results are carried through the calculations that yield the final result and the final result is rounded to the number of significant figures appropriate to the accuracy of the analytical method. Please note that results appearing in the columns preceeding the final result column may have been rounded in order to fit the report format and therefore, if carried through the calculations, may not yield an identical final result to the one reported.

The stated LOQs for each analyte represent the demonstrated LOQ concentrations prior to correction for desorption efficiency (if applicable).

Unless otherwise noted below, reported results have not been blank corrected for any field blank or method blank.

L277617 (Report ID: 759365):
SOPs: ii-n6011(8)
Chlorine quantitated as Cl2 in the ppm calculation.

L277617 (Report ID: 759144):
SOPs: ii-ncl3(3)

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

GALSON LABORATORIES

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East Syracuse, NY 13057
Tel: (315) 432-5227
888-432-LABS (5227)
Fax: (315) 437-0571
www.galsonlabs.com

☐ New Client?

Client Account No.°: _____

Report To° : Frank Riordan
ARCH Consulting Group, LLC
5607 Keystone Pl N
Seattle, WA 98103
Phone No.° : 206-301-8989
Cell No. : 206-618-3088
Email Results to : Frank
Email address : frank@archconsultants.com

Invoice To° : Frank Riordan
Phone No. :
Email :
P.O. No. :
Credit Card : ☐ Card on File ☐ Call for Credit Card Info.

☐ Samples submitted using the FreePumpLoan™ Program ☐ Samples submitted using the FreeSamplingBadges™ Program

Need Results By:	(surcharge)
☑ 5 Business Days	0%
☐ 4 Business Days	35%
☐ 3 Business Days	50%
☐ 2 Business Days	75%
☐ Next Day by 6pm	100%
☐ Next Day by Noon	150%
☐ Same Day	200%

Site Name : Lynnwood Rec Center Project : 2012-1525 Sampled by : Frank Riordan

Comments : Samples Received In Light Sensitive Material: Yes or No

List description of Industry or Process/interferences present in sampling area :

State samples were collected in (e.g., NY): WA

Please indicate which OEL this data will be used for : ☑ OSHA PEL ☐ ACGIH TLV ☐ Cal OSHA ☐ MSHA ☐ Other (specify):

Sample Identification° (Maxmium of 20 Characters)	Date Sampled	Collection Medium (Cyclone)	Sample Volume Sample Time Sample Area°	Sample Units°: L, ml,min,in2,cm2,ft2	Analysis Requested°	Method Reference^	Hexavalent Chromium Process (e.g., welding plating, painting, etc.)°
#1-NCl3-1-3	11/03/12	Treated Filter	134.2	L	Nitrogen Trichloride	In-House	
#2-Cl-1-3	11/03/12	Silver Membrane	134.2	L	Chlorine	Mod NIOSH 6011	
#3-NCl3-3-6	11/03/12	Treated Filter	181.5	L	Nitrogen Trichloride	NIOSH 9102	
#4-Cl-3-6	11/03/12	Silver Membrane	181.5	L	Chlorine	Mod NIOSH 6011	
#5-NCl3-6-8:45	11/03/12	Treated Filter	185.9	L	Nitrogen Trichloride	Mod. OS 125G	
#6-Cl-6-8:45	11/03/12	Silver Membrane	185.9	L	Chlorine	Mod NIOSH 6011	
#7-Kari-NCl3	11/03/12	Treated Filter	535.7	L	Nitrogen Trichloride	Mod. OS 125G	
#8-Stephen-Cl	11/03/12	Silver Membrane	528	L	Chlorine	Mod NIOSH 6011	

^Galson Laboratories will subsititute our routine/preferred method if it does not match the method listed on the COC unless this box is checked: ☐ Use method(s) listed on COC

For metals analysis: if requesting an analyte with the option of a lower LOQ, please indicate if the lower LOQ is required (only available for certain analytes - see SAG) :

For crystalline silica: form(s) of silica needed must be indicated (Quartz, Cristobalite, and/or Tridymite)° :

Chain of Custody	Print Name	Signature	Date/Time
Relinquished by :	Frank Riordan	F. Riordan	11/5/12
Received by LAB :			11/6/12 802

Samples received after 3pm will be considered as next day's business
° Required fields, failure to complete these fields may result in a delay in your samples being processed.

Page 1 of 1

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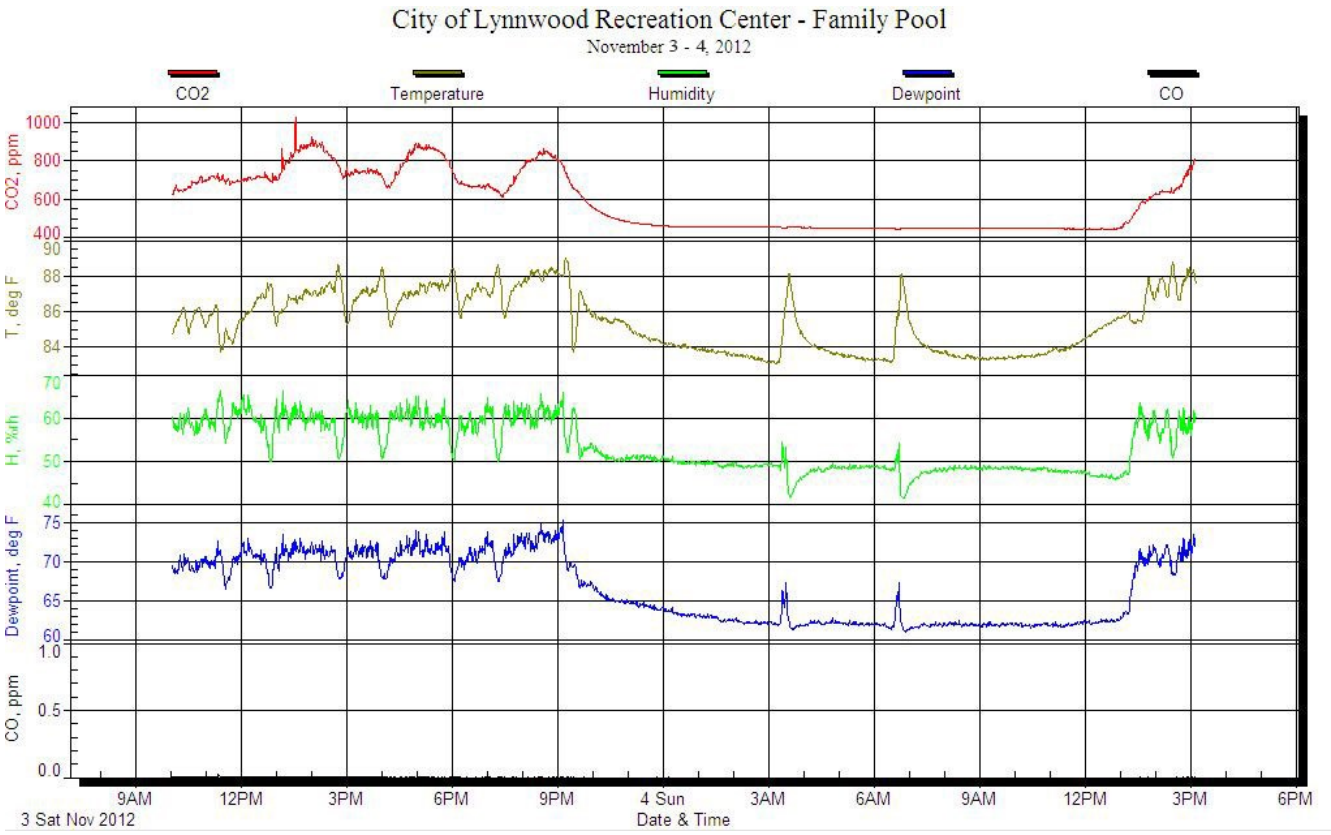
APPENDIX 2

2012 RESULTS

NORTH POOL (REC POOL) INDOOR AIR QUALITY RESULTS



Graph Statistics

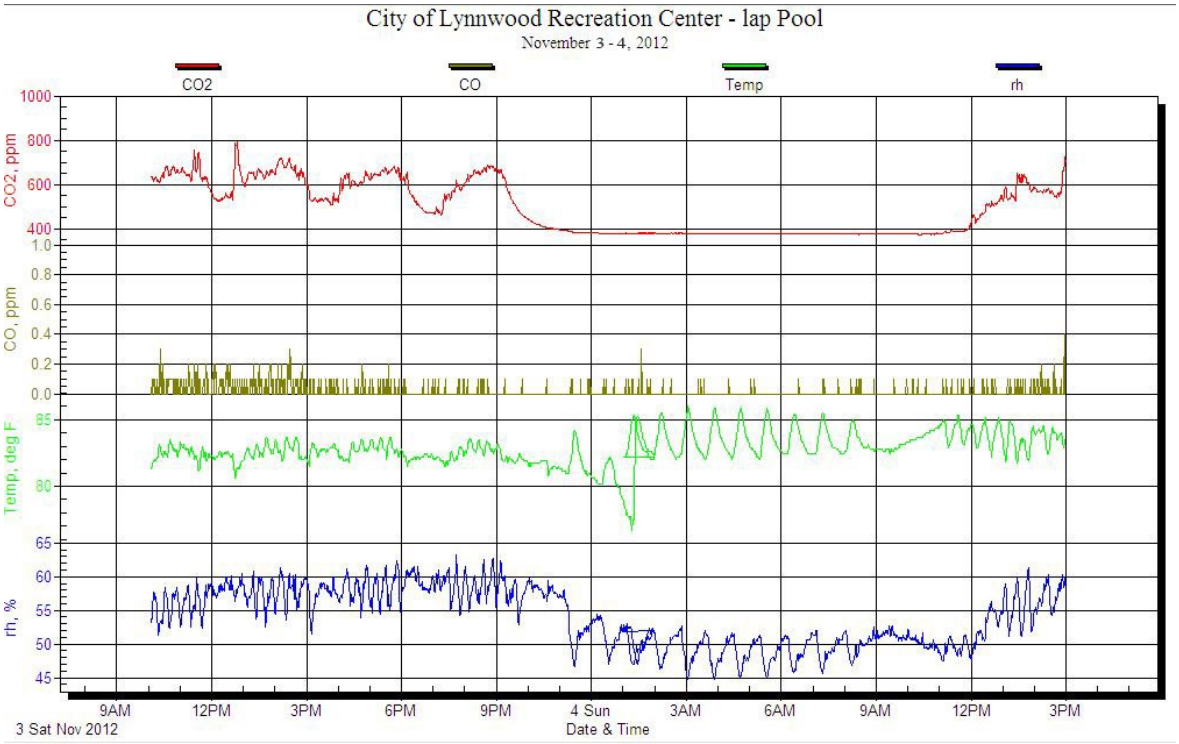
Statistics					
	CO2	T	H	Dewpoint	CO
Avg	586 ppm	85.4 deg F	53.5 %rh	66.5 deg F	0.0 ppm
Max	1026 ppm	89.0 deg F	66.3 %rh	75.3 deg F	0.0 ppm
Max Date	11/03/2012	11/03/2012	11/03/2012	11/03/2012	11/03/2012
Max Time	13:32:41	21:13:39	13:10:41	21:08:39	11:20:42
Min	444 ppm	83.1 deg F	41.6 %rh	61.1 deg F	0.0 ppm
Min Date	11/04/2012	11/04/2012	11/04/2012	11/04/2012	11/03/2012
Min Time	06:41:36	03:12:37	06:50:36	06:53:36	10:16:42
TWA (8 hr)	760				0.0
TWA Start Date	11/03/2012				11/03/2012
TWA Start Time	10:02:42				10:02:42
TWA End Time	15:08:42				15:08:42

A.R.C.H.
CONSULTING GROUP, LLC

APPENDIX 2

2012 RESULTS

SOUTH POOL (LAP POOL) INDOOR AIR QUALITY RESULTS



Graph Statistics

Statistics				
	CO2	CO	Temp	rh
Avg	488 ppm	0.0 ppm	82.8 deg F	53.9 %
Max	795 ppm	0.4 ppm	86.0 deg F	63.2 %
Max Date	11/03/2012	11/04/2012	11/04/2012	11/03/2012
Max Time	12:48:36	14:56:36	03:03:36	19:44:36
Min	373 ppm	0.0 ppm	76.7 deg F	44.8 %
Min Date	11/04/2012	11/03/2012	11/04/2012	11/04/2012
Min Time	10:21:36	10:05:36	01:16:36	03:02:36
TWA (8 hr)	624	0.0		
TWA Start Date	11/03/2012	11/03/2012		
TWA Start Time	10:05:36	10:05:36		
TWA End Time	14:59:36	14:59:36		

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APPENDIX 4

WATER CHEMISTRY DATA

DATA WAS COLLECTED BY REC CENTER STAFF

LSI DATA

EXACT	pH	Temp Fac	Cal Fac	Alk Fac	TDS Fac	LSI
Lap	7.4	0.71	1.9	2.1	12.2	-0.09
Wellness	7.4	0.75	1.82	1.7	12.2	-0.53
Adult	7.4	0.88	2.04	1.54	12.2	-0.34
Rec	7.4	0.71	2.15	1.7	12.2	-0.24
Family	7.6	0.83	1.97	1.6	12.2	-0.2
TAYLOR	pH	Temp Fac	Cal Fac	Alk Fac	TDS Fac	LSI
Lap	7.4	0.71	2.17	2.12	12.2	0.2
Wellness	7.4	0.75	2.17	1.92	12.2	0.04
Adult	7.4	0.88	2.02	1.6	12.2	-0.3
Rec	7.4	0.71	2.2	1.92	12.2	0.03
Family	7.6	0.83	2.04	1.7	12.2	-0.03
	Average LSI					
Lap	0.055					
Wellness	-0.245					
Adult	-0.32					
Rec	-0.105					
Family	-0.115					

TEMPERATURE TREND

	PDH2		PDH1		Outside		Weather Undergrou	
Time	Temp	RH	Temp	RH	Temp	RH	Temp	RH
8am	82.4	48.1	81.3	51.3	52.7	92.3		
9am	87.8	38.6	80.8	53.7	53.4	91.2		
10am	83.9	55.7	81.6	51.5	54.6	85.3	54	98
11am	85.7	52.7	81.1	53.2	55	85.5	54.7	96
12pm	75.4	58.5	80.8	53.3	55.4	84.7	55.2	95
1pm	85	59.7	81.6	81.6	56.1	87.7	55.4	96
2pm	86.3	57.8	82.8	82.8	58.8	80.2	55.8	96
3pm	85.9	57.7	82.2	52.5	59.5	80	57.2	94
4pm	84.9	59.9	81.9	54.4	60	78.3	57.7	93
5pm	86.3	58.8	83	51.4	60	77.4	57.7	93
6pm	85	58.6	81.7	53.6	59.1	73.1	57.1	94
7pm	85.5	58	81.3	54	59.7	78.3	56.8	95
8pm	87.2	60.5	82.6	52.8	59.9	74.6	55.8	95

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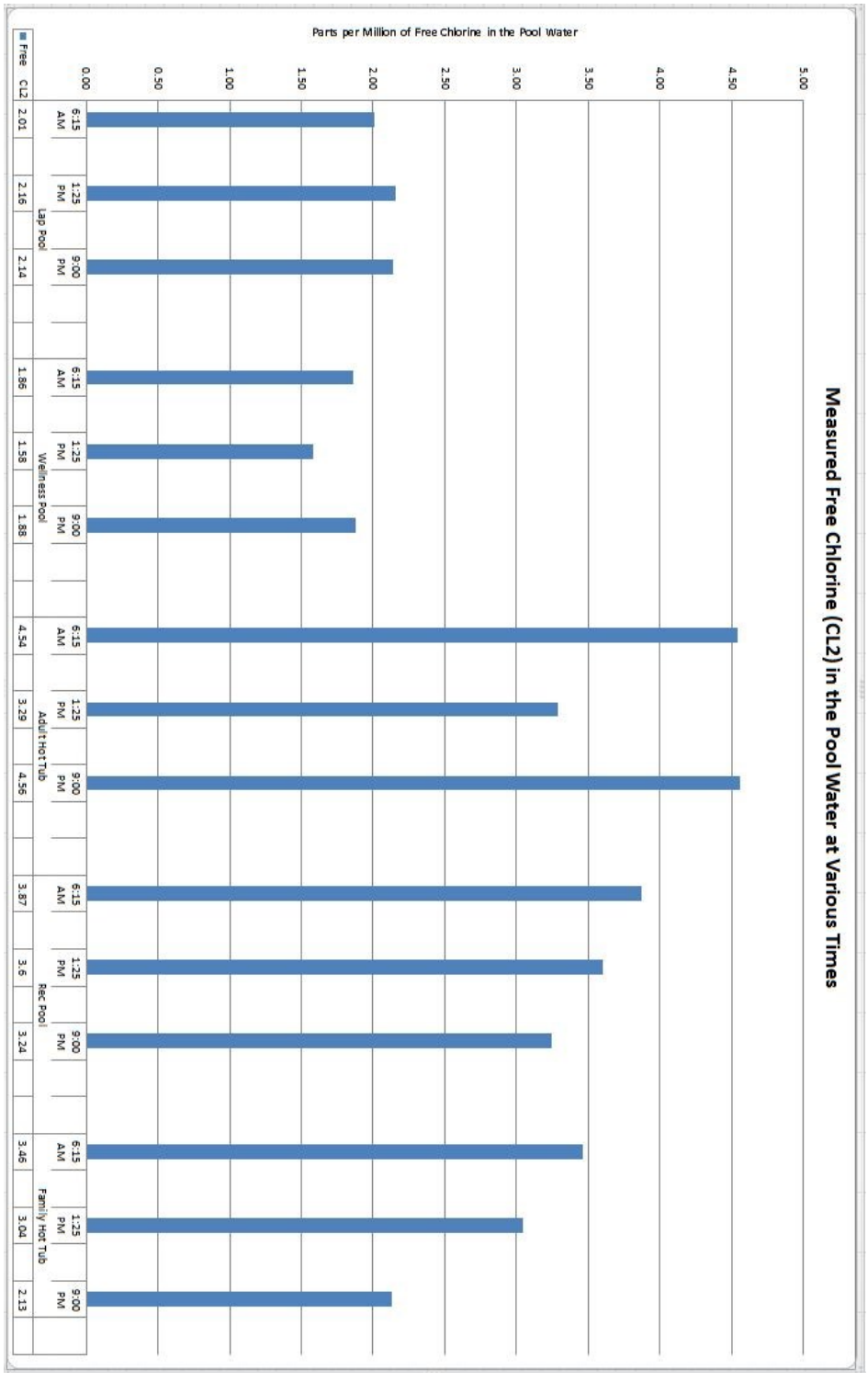
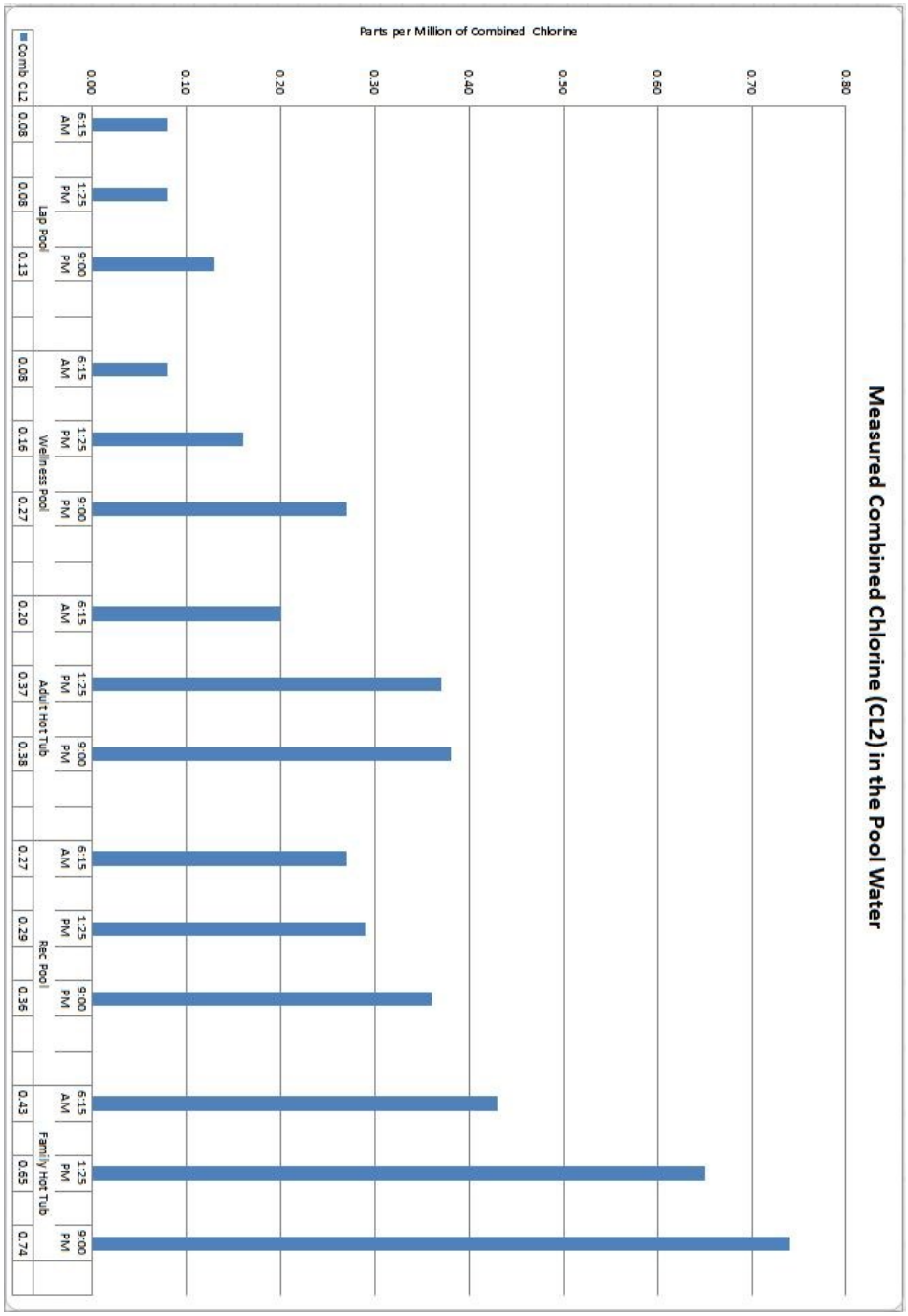
CHEM CHECKS

These are the values used in the charts below to compare with air samples.

			DATE	11/3/2012 Saturday						
		Time	Free CL2	Comb CL2	pH Tested	pH Reading	HRR	Temp	Flow Rate	TDS Rea / Temp Re
Lap Pool	1	6:15am	2.01	0.08	7.4	7.5	816	85	1074	1060 / 85
	2	1:25pm	2.16	0.08	7.5	7.5	815	85	1103	
	3	9:00pm	2.14	0.13	7.5	7.5	815	85	1086	
Wellness Pool	1	6:15am	1.86	0.08	7.4	7.4	794	90	509	1560 / 89.2
	2	1:25pm	1.58	0.16	7.4	7.4	782	89	512	
	3	9:00pm	1.88	0.27	7.6	7.5	791	91	509	
Adult Hot Tub	1	6:15am	4.54	0.20	7.4	7.3	770	101	153	2270 / 103
	2	1:25pm	3.29	0.37	7.4	7.3	769	101	153	
	3	9:00pm	4.56	0.38	7.6	7.4	769	101	153	
Rec Pool	1	6:15am	3.87	0.27	7.4	7.4	628	84	1495	1690 / 86.5
	2	1:25pm	3.6	0.29	7.6	7.5	636	83	1486	
	3	9:00pm	3.24	0.36	7.6	7.4	629	85	1477	
Family Hot Tub	1	6:15am	3.46	0.43	7.6	7.5	779	97	189	1850 / 98.2
	2	1:25pm	3.04	0.65	7.6	7.5	784	96	182	
	3	9:00pm	2.13	0.74	7.4	7.2	762	98	186	


Measured Free Chlorine (CL2) in the Pool Water at Various Times
Parts per Million of Free Chlorine in the Pool Water
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Free Cl2
Lap Pool
6:15 AM 2.01
1:25 PM 2.16
9:00 PM 2.14
Wellness Pool
6:15 AM 1.86
1:25 PM 1.58
9:00 PM 1.88
Adult Hot Tub
6:15 AM 4.54
1:25 PM 3.29
9:00 PM 4.56
Rec Pool
6:15 AM 3.87
1:25 PM 3.6
9:00 PM 3.24
Family Hot Tub
6:15 AM 3.46
1:25 PM 3.04
9:00 PM 2.13

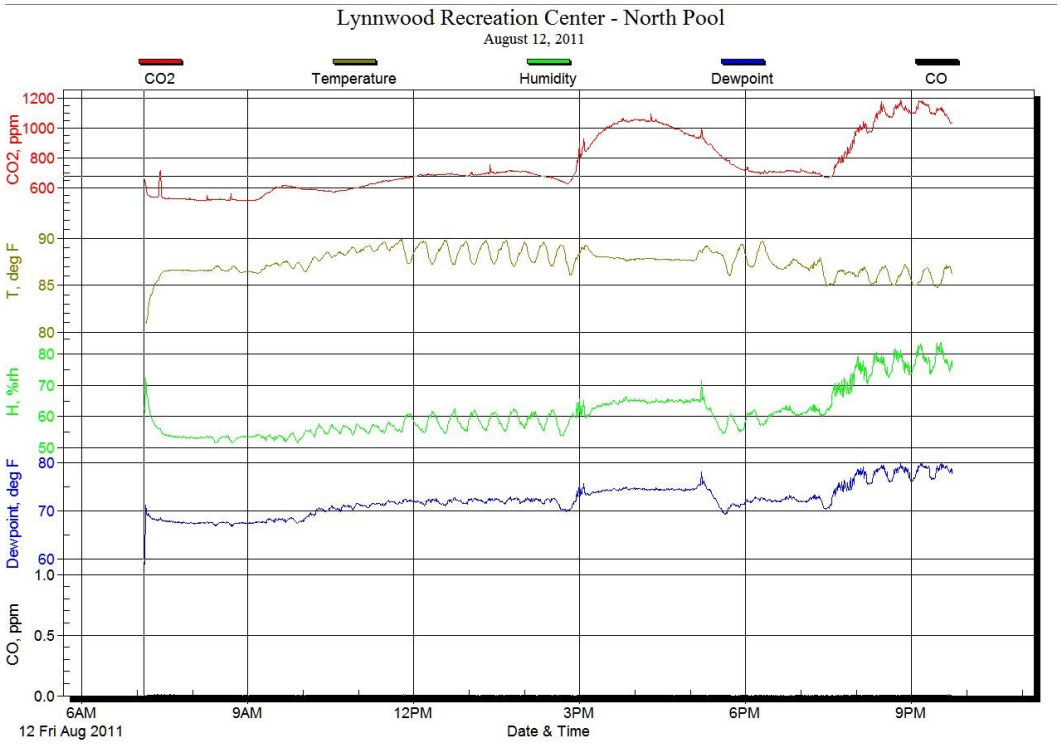

Measured Combined Chlorine (CL2) in the Pool Water
Parts per Million of Combined Chlorine
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
Comb CL2
0.08
0.08
0.13
0.08
0.16
0.27
0.20
0.37
0.38
0.27
0.29
0.36
0.43
0.65
0.74
6:15 AM
1:25 PM
9:00 PM
Lap Pool
Wellness Pool
Adult Hot Tub
Rec Pool
Family Hot Tub

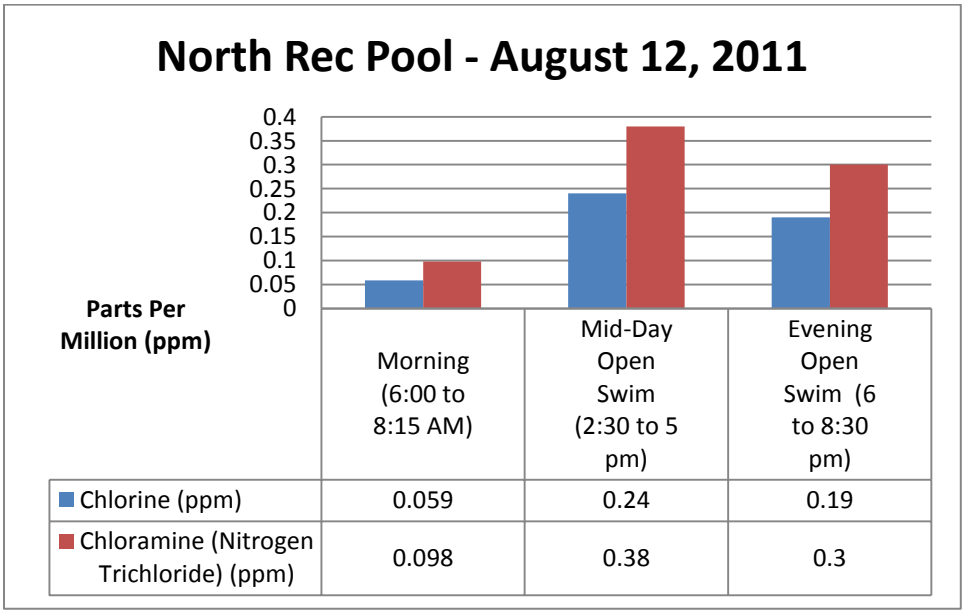
APPENDIX 5

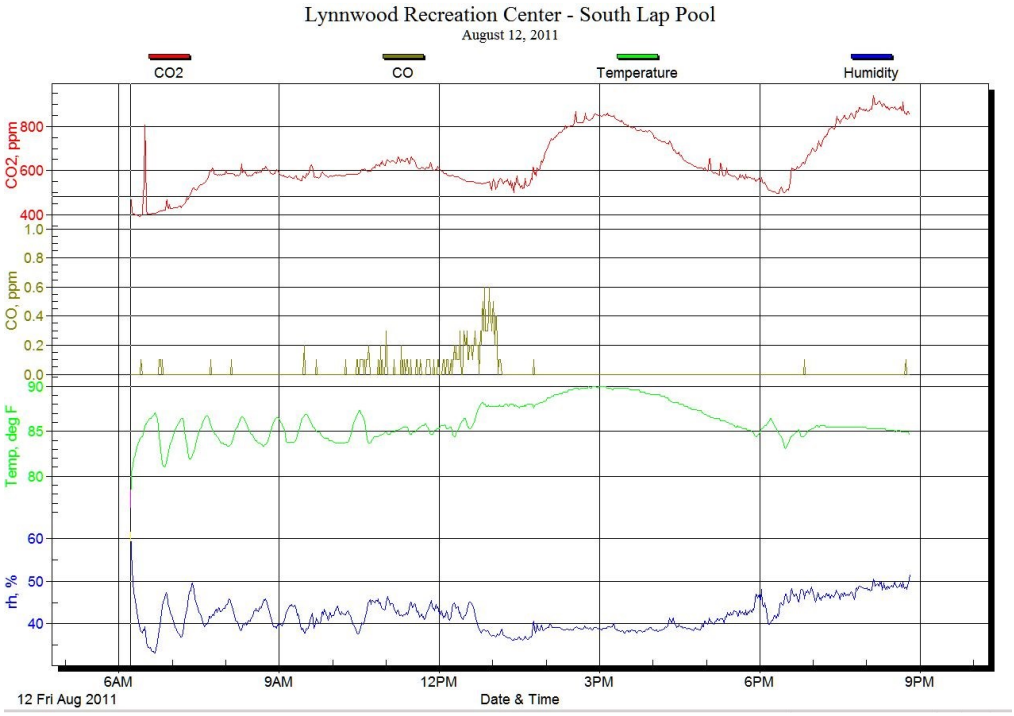
2011 RESULTS

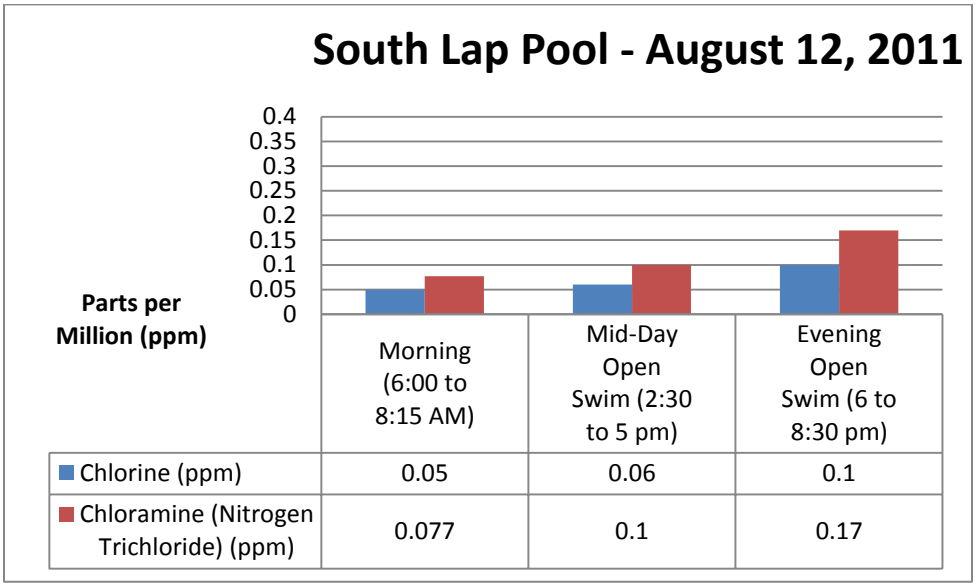
NORTH (REC) & SOUTH (LAP) POOL

INDOOR AIR QUALITY, CHLORINE & CHLORAMINE RESULTS


Lynnwood Recreation Center - North Pool
August 12, 2011
CO2
Temperature
Humidity
Dewpoint
CO
CO2, ppm
T, deg F
H, %rh
Dewpoint, deg F
CO, ppm
6AM
9AM
12PM
3PM
6PM
9PM
12 Fri Aug 2011
Date & Time


North Rec Pool - August 12, 2011
Parts Per Million (ppm)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Morning (6:00 to 8:15 AM)
Mid-Day Open Swim (2:30 to 5 pm)
Evening Open Swim (6 to 8:30 pm)
Chlorine (ppm)
0.059
0.24
0.19
Chloramine (Nitrogen Trichloride) (ppm)
0.098
0.38
0.3





	Morning (6:00 to 8:15 AM)	Mid-Day Open Swim (2:30 to 5 pm)	Evening Open Swim (6 to 8:30 pm)
Chlorine (ppm)	0.05	0.06	0.1
Chloramine (Nitrogen Trichloride) (ppm)	0.077	0.1	0.17